

Alpha and Neutrino Spectra from ^8B Beta–Decay

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The primary source of high energy neutrinos from the sun is the beta decay of ^8B , which is produced by nucleosynthesis deep in the solar interior. The exact spectral shape of the neutrinos from ^8B is of current interest because of recent results from the SuperKamioKande and Sudbury Neutrino Observatory collaborations. These results may be explained by neutrino oscillations which are accompanied by a distortion in the observed neutrino spectrum. The beta decay of ^8B is allowed and the decay proceeds primarily to the unbound first excited state of ^8Be at 2.9 MeV, which decays to two alpha particles. The ^8B beta and neutrino spectra deviate from the allowed shape due to the broad and complicated energy profile of the final state. We are currently working on an experiment to measure the beta-delayed alpha spectrum from ^8B using the novel technique of implanting ^8B in a silicon detector. Previous experiments used ^8B implanted externally in thin metallic foils and the uncertainties of the foil and source thicknesses are suspected to be the source of the discrepancies. The technique involves the production of a ^8B beam using the ATLAS accelerator at Argonne National Lab to bombard a ^3He gas cell with a ^6Li beam, using the $^3\text{He}(^6\text{Li},n)^8\text{B}$ reaction. Boron nuclei with the proper energy for implantation are selected by the ATLAS Spectrograph and deposited into the center of a 91 micrometer Silicon detector located in the Spectrograph focal plane. This setup eliminates systematic errors associated with alpha energy loss in catcher foils and detector dead layers, and minimizes the error due to beta energy deposition by requiring a coincidence hit with a 0.8 mm plastic scintillator located 4 cm away from the silicon detector, and sharing its central axis. We use ^{20}Na for calibration, which decays by beta-delayed alpha

emission about 20% of the time and produces alpha lines with energies above and below the peak of the ^8B spectrum. The ^{20}Na was produced using the $^3\text{He}(^{19}\text{F},2n)^{20}\text{Na}$ reaction, and implanted in the detector in a similar manner. External sources are also used for calibration. In 2001, three runs at ATLAS took place. The first was in May and ^8B ions were successfully implanted into the Si detector and a preliminary spectrum taken. The second, in October, was a test run for ^{20}Na production. We attained a beam of 2–3 ions per second through the magnet, sufficient to perform the calibration. The final run of 2001 was in December and implantation of both ^8B and ^{20}Na was achieved, and the coincidence scintillator was utilized for the first time. We observed 50,000 coincident events in the alpha spectrum, and an analysis of the data is being carried out at present. A final measurement, which will eliminate small problems with the experimental setup and provide adequate statistics, is being planned for summer 2002.

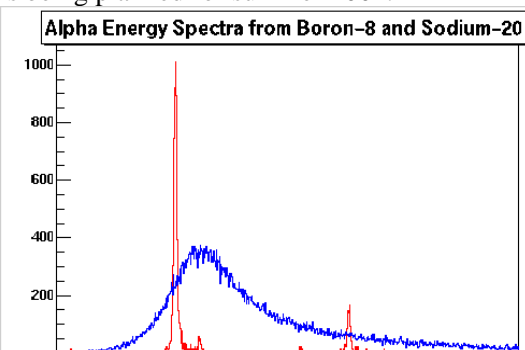


Figure 1. Data from the most recent run. The blue histogram is the ^8B alpha spectrum, while the red is the ^{20}Na calibration. Both are in beta-coincidence.

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[2] J.N Bahcall, *et al.*, Phys Rev C58, 411 (1996)

[3] C. Ortiz, *et al.*, Phys Rev Lett 85, 2909 (2000)